Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S | **S C C S**

Canadian Stock Assessment Secretariat | **Secrétariat canadien de consultation scientifique**

Research Document 2002/027 | **Document de recherche 2002/027**

Not to be cited without Permission of the authors [1] | Ne pas citer sans autorisation des auteurs [1]

Status of Atlantic salmon (*Salmo salar* L.) in Trout River (SFA 14A), Gros Morne National Park of Canada, Newfoundland, 2001

État du stock de saumon atlantique (*Salmo salar* L.) de la rivière Trout (ZPS 14A) dans le parc national du Gros-Morne (Terre-Neuve) en 2001

Hugh McCormack, Thomas W. Knight, and / et Todd Gallant

Resource Conservation
Gros Morne National Park of Canada
P.O. Box 130
Rocky Harbour, Newfoundland
Canada A0K 4N0

[1] This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

[1] La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au Secrétariat.

This document is available on the Internet at: Ce document est disponible sur l'Internet à:
http://www.dfo-mpo.gc.ca/csas/

ISSN 1480-4883
© Her Majesty the Queen in Right of Canada, 2002
© Sa majesté la Reine, Chef du Canada, 2002
Canada

Abstract

During the period June - August, 2001, a fish counting fence was established for the first time on the lower part of Trout River, Newfoundland, in Salmon Fishing Area (SFA) 14A. Approximately 55 % of the watershed is located within the boundaries of Gros Morne National Park of Canada. The remaining 45 % of the watershed is located east of the Park's south-east boundary in Provincial Forest Management Area 15. A total of 51 adult anadromous Atlantic salmon (*Salmo salar*) (consisting of 15 large [≥ 63 cm fork length] and 36 small [<63 cm fork length] fish) returned to the river during the period of operation. Data from Trout River were not available to determine the values of several variables important in the calculation of egg deposition. In these cases data from other rivers in SFA 14A were substituted to provide a range of potential egg deposition values. Assuming that these substituted values are consistent with those from Trout River, adult salmon runs to the watershed fall significantly short of Department of Fisheries and Oceans conservation requirements. Preliminary investigations into the status of the exotic species rainbow trout (*Oncorhynchus mykiss*) were conducted in conjunction with this study.

Résumé

De juin à août 2001, nous avons installé pour la première fois une barrière de dénombrement des poissons sur le cours inférieur de la rivière Trout, située dans la zone de pêche du saumon (ZPS) 14A à Terre-Neuve. Environ 55 % du bassin versant est situé dans le parc national du Gros-Morne, et le reste (45 %) se trouve à l'est de la limite sud-est du parc dans la zone provinciale d'aménagement forestier 15. Au total, 51 saumons atlantiques anadromes adultes (comprenant 15 gros saumons [longueur à la fourche ≥ 63 cm] et 36 petits [longueur à la fourche < 63 cm]) sont revenus à la rivière. Aucune donnée sur la rivière Trout n'était disponible afin de déterminer la valeur de plusieurs variables importantes pour le calcul de la ponte. Nous avons donc utilisé des données obtenues pour d'autres rivières de la ZPS 14A pour calculer l'étendue des valeurs de ponte possibles. Si nous supposons que ces valeurs de substitution sont représentatives de celles de la rivière Trout, la remonte de saumons adultes vers le bassin versant est très insuffisante pour satisfaire les impératifs de conservation du ministère des Pêches et des Océans. Parallèlement à cette étude, nous avons effectué une étude préliminaire de l'état du stock de truite arc-en-ciel (*Oncorhynchus mykiss*), une espèce exotique.

Introduction

Trout River is a scheduled salmon river located in Salmon Fishing Area (SFA) 14A (Figure 1). It has a total watershed area of 258 km^2 of which 143 km^2 or 55 % is contained within the boundaries of Gros Morne National Park. The remainder is located in the Provincial Forest Management Area 15. It is one of four scheduled salmon rivers within the Park. The watershed is comprised of two major river sections; the main stem and tributaries of Trout River, which form the southeast end of the system, and the "Feeder", which drains off the south flank of the Tablelands and enters the main river channel approximately two km upstream from the mouth of the river. In addition, there are two large ponds (Trout River Inner and Outer Ponds) and numerous small brooks in the system (Figure 1). The main stem drainage drops from a maximum elevation of 434 m to approximately 10 m over an axial distance of approximately 10 km to its inlet to Trout River Inner Pond. It drops a further 10 m through Trout River Inner and Outer Ponds over an axial distance of 22 km to its discharge into the Gulf of St. Lawrence. The "Feeder" drainage has a maximum elevation of 700 m and drops to 5 m over an axial distance of 9.5 km to its convergence with the main river. More than 50 % of the "Feeder" watershed is rendered inaccessible to anadromous Atlantic salmon (*Salmo salar*) by a 10 m waterfall.

Trout River has experienced a wide range of catch as well as catch per unit effort during the period 1974-2000 (DFO licence stub return data, unpublished) and little is known of historical populations of salmon in the system (Parks Canada 1990). The recreational salmon fishery in Trout River is currently regulated under the Newfoundland Fisheries Regulations. The pending proclamation of Gros Morne as a National Park requires that Parks Canada incorporate Trout River into its fishery regulations under the Canada National Parks Act (CNPA) for that portion of the watershed within its jurisdiction. The CNPA requires Parks Canada to manage the recreational salmon fishery on Trout River in a sustainable manner. The installation of a fish counting fence for the first time on Trout River in 2001 is a preliminary step in acquiring the needed data.

Methods and Results

COUNTING FENCE

A fish counting fence was installed on the main branch of Trout River approximately 150 m downstream from the confluence of the "Feeder" and approximately 2 km upstream from the river mouth (Figure 1). The fence consisted of a smolt trap opening upstream to collect all seabound fish and an adult trap opening downstream to collect all fish moving upstream. The smolt trap was completed and operating on June 5, 2001. The adult trap began operating June 6. The fence was monitored daily from June 5 until September 2, 2001 when a storm induced flood washed out the entire centre portion of the fence including both traps. Local wind speed and direction, weather conditions, cloud cover, air and water temperature and water level at the adult trap were recorded each time the fence was checked. On July 7 a temperature logger was installed in the adult trap to take hourly measurements of water temperature (Figure 2). Fish in each trap were identified to species and fork lengths were taken on all species except adult small and large salmon that were moving upstream. When water temperatures were greater than 18 ^{0} C, no fish were measured and handling was kept to a minimum to avoid stress to the fish.

ADULT RETURNS AND SPAWNING ESCAPEMENT

(a) Adult Count and Run Timing

All adult salmon caught in the adult trap were identified as small [grilse] (< 63 cm) or large (>63 cm) and were released upstream with a minimum of handling. No other morphometric data were taken from these fish. The first two fish (an adult large salmon and a grilse) were found in the trap on June 25 and the last fish caught were an adult large salmon and a grilse on August 26 (Figure 3). Salmon were caught sporadically through the intervening period. A total of 51 adult salmon (grilse = 36, large salmon = 15) were caught in the trap (Figure 3).

The run timing of grilse was defined as the dates that the 25th, 50th, and 75th percentile of the cumulative count occurred which corresponded to July 9th, July 23rd, and August 17th, respectively.

(b) Adult Returns

The total return to the river (**TRR**) of grilse and adult large salmon is based on the count at the fish fence. While some angling was observed downstream from the fence over the course of fence operation, contact with the anglers indicated that no salmon were caught below the fence. Some salmon arrived in the trap with recent wounds possibly from jig hooks. None were observed to have net marks although larger sea run brook trout (*Salvelinus fontinalis*) that entered the trap during the period July 11 - August 11 were observed, on many occasions, to have net marks. Since there are no means to determine how many, if any, salmon were netted during that period no other adjustments have been made to the **TRR** to account for any other mortality above or below the fence.

(c) Spawning Escapement

Spawning escapement for adult small and large salmon were calculated separately as follows:

SE = TRR - RET - HRM

Where: **TRR** = total return of adult small or large salmon
RET = estimate of retained catches
HRM = hook and release mortality

Since creel data are not available for Trout River for 2001, DFO catch estimates from licence stub returns for 2001 were used to approximate **RET.** Likewise, no data for Trout River are available for **HRM** so it was assumed that 10% of released salmon die (Dempson et al. 2002). Similarly, DFO data from licence stub returns were used to estimate **REL**. Therefore:

HRM = REL x 0.1

Where: **REL** = estimate of released salmon

CONSERVATION REQUIREMENTS AND POTENTIAL EGG DEPOSITIONS

(a) Conservation Requirements

Conservation requirements (number of eggs) were calculated based on 2.4 eggs/m^2 for fluvial habitat (Elson 1975) and 368 eggs/ha for lacustrine habitat (O'Connell et al. 1991). Fluvial habitat included all riffle and run area for Trout River as determined by Hickey (1983). Run habitat was included since the various run channels could be considered rearing habitat, especially at lower water levels typical of the summer. The fluvial habitat measured by Hickey does not appear to include the "Feeder". Lacustrine habitat was calculated as the surface area of both Trout River Inner and Outer Ponds at a depth of 20 m or less plus all the area of all pools in the various river channels (Kerekes and Schwinghamer 1975, Hickey 1983). As noted above, Hickey's (1983) data for pool area does not appear to include the "Feeder".

CR = (fluvial area x 2.4) + (lacustrine area x 368)
= (169330 x 2.4) + (366.2 x 368)
= 541152 eggs

(b) Potential Egg Deposition

Fecundity for large and small adult salmon was calculated to be:

F = RF x MW

Where: **RF** = relative fecundity (# eggs/kg)
MW = mean weight of all fish

There are no **RF** or **MW** data for Trout River at this time. We used a relative fecundity of 1783 eggs/kg body weight, estimated from salmon in Western Arm Brook (Chadwick et al. 1986). Knight (2001) reported mean weights of 2.076 kg for adult small salmon and 4.144 kg for adult large salmon in Deer Arm Brook. The mean weights reported by Mullins et al. (2001) for Lomond River were 1.58 kg for adult small salmon and 3.62 kg for adult large salmon. It is not known how the mean weights of salmon from Trout River compare with those of other nearby rivers. However, for the purposes of the analysis mean weight data from both Deer Arm Brook and Lomond River were used. Values for fecundity were calculated for both small and large adult salmon using the respective weights above.

Potential egg deposition was estimated by:

ED = SE x PF x F

Where: **SE** = spawning escapement
PF = proportion of females
F = fecundity

It is not known what proportion of the fish returning to Trout River is made up of female fish. Mullins et al. (2001) report a range of **PF** for small and large salmon on the Lomond and Torrent Rivers and Western Arm Brook. For small salmon the **PF** ranged from .586 to .822 and the **PF** for large salmon ranged from .638 to .857. Four values for **ED** were

calculated. Two were for small salmon using the lowest and highest **PF** and two were for large salmon using the lowest and highest **PF**.

The percentage of conservation egg deposition requirement (**CR**) was calculated by:

% eggs achieved = ED(small + large) / CR

Since several values for **SE** and **ED** were calculated based on ranges of input values, there was a range of values achieved for **% eggs achieved**.

Results Of Analysis

Preliminary DFO licence stub return data for 2001 show that a total of 28 adult small salmon were retained and 7 were released, and 2 adult large salmon were caught, both of which were released. Using these values for **RET** and **REL** and the mean weight values from Lomond River gives the results reproduced as Table 1.

Using the same values for **RET** and **REL** and the mean weight values from Deer Arm Brook gives the results reproduced as Table 2.

DFO data also provide 5 year running mean values for **RET** and **REL** for both large salmon and grilse. The results, using the values for the period 1992 - 1996, and **MW** data from Lomond River and Deer Arm Brook are reproduced as Table 3.

Assuming that all fish that passed through the Trout River counting fence continued on to spawn (i.e., none were removed from the system, **SE** = 100 %) the same analysis was performed using **MW** data from Lomond River and Deer Arm Brook. The results of this analysis are reproduced as Table 4.

Discussion

The analysis of data presented in Tables 1 through 4 present a disturbing picture of the potential status of the salmon stock on Trout River. The outcome for percent **eggs achieved** is consistently below the conservation requirements predicted for the river and ranges from a lowest value (Table 1) of 13.5 % to a highest value of 37.8 % (Table 4). The results in Table 1 assume that 2001 final catch rates on Trout River are identical to the preliminary data from 2001 for Trout River while those of Table 4 assume that no fish were removed from the system in 2001 (i.e., 100 % **SE**). For the purposes of discussion these two results represent the worst-case and best-case scenarios, respectively, while the other results lie somewhere in between.

Much of the data used in the preparation of percent eggs achieved is derived from other river systems and assumes that they are consistent among systems even though mean weight and the proportion of females is known to vary. Regardless, even assuming a high proportion of females and the largest mean weight published for salmon in SFA 14A (Knight 2001), the **% CR** is still only 37.8 (Table 4).

Poaching is known to occur on Trout River and it has been indicated that large sea run brook trout (*Salvelinus fontinalis*) entered the trap with fresh net marks during the period July 11 - August 11. It is not known what if any numbers of salmon were illegally caught during this period. However it is evident that, with such low numbers of returning salmon, any poaching losses would have a significant impact on the egg production in a given year and a consequent impact in the numbers of salmon returning in subsequent years.

It has also been noted that Hickey's (1983) study does not appear to include spawning habitat in the "Feeder". While the missing data are not available from other sources, it should be noted that the inclusion of the "Feeder" habitat would only serve to increase the **CR** for the system. This would result in lower values for **% CR achieved**.

It is reasonable to assume, therefore, that the status of the Trout River salmon stock in 2001 falls somewhere in the range of the data presented. It is also important that, in order for Parks Canada to properly manage the salmon population on Trout River, data specific to Trout River should be used in population status modelling and, where that data is not currently available, studies should be implemented to fill the gaps.

Relatively recently, Trout River has been colonized by exotic rainbow trout (*Oncorhynchus mykiss*) posing an additional threat to its depleted salmon stock. In 2001, a total of 8 adult rainbow trout were captured in the adult trap and 8 in the smolt trap at the fish fence. In addition, 62 rainbow trout fry (positive identification to be determined) were caught in the smolt trap and juveniles were captured through electrofishing in the "Feeder", indicating successful reproduction in the Trout River system (Mullins and Porter 2002). These rainbow trout are believed to have escaped from aquaculture facilities in Cape Breton (Porter 2000) and their successful colonization of Trout River suggests that they could become established in neighbouring river systems (including others within Gros Morne National Park) along Newfoundland's west coast. Rainbow trout are competitors of Atlantic salmon and are known to displace Atlantic salmon from some habitats (Gibson 1981, Hearn and Kynard 1986). The actual impact of rainbow trout in the Trout River system requires further investigation.

Some discussion is necessary concerning the location of the Trout River fish fence in 2001. The location chosen was based on consultation between DFO and Parks Canada staff. There were concerns expressed that a fence located upstream from the confluence of the "Feeder" might influence upstream migration patterns of salmon and force some of them into the "Feeder". The "Feeder" is a relatively short and steep drainage with limited forest cover in its headwaters and is susceptible to flash flooding during periods of high rainfall. On two occasions the fence was over topped by the runoff after extreme rain events. The first caused minor damage to the fence but the second caused the loss of the smolt trap and several span sections of the fence. It is recommended, therefore, that in 2002 the fence be relocated upstream from the confluence of the "Feeder" and that a smaller fence be used specifically for the "Feeder". While this will cause some increased operating requirements it will be offset by the increased safety to staff working around the fence during periods of high runoff.

Acknowledgments

We thank the following employees of Parks Canada who assisted in the installation and removal of the fence: Myles Bennett, Cecil Oates, Ray Reid, Russell Sparkes. Scott Taylor of Parks Canada produced Figure 1. We thank the following employees of DFO for their assistance in the planning and installation of the fence: Don Caines, Lloyd Fudge, Conrad Mullins, and Rex Porter. Thank you also goes to Lloyd Fudge of DFO for his assistance in operating the fence all season.

References

Chadwick, E.M.P., R.G. Randall, and C. Leger. 1986. Ovarian development of Atlantic salmon (*Salmo salar*) smolts and age at first maturity. Can. Spec. Publ. Fish. Aquat. Sci. **89**.

Dempson, J.B., G. Furey, and M. Bloom. 2002. Effects of catch and release angling on Atlantic salmon, Salmo salar L., of the Conne River, Newfoundland. Fish. Manage. Ecol. **9**: 139-147.

Elson, P.F. 1975. Atlantic salmon rivers smolt production and optimal spawning. An overview of natural production. Int. Atl. Salmon Found. Spec. Publ. Ser. **6**: 96-119.

Gibson, R.J. 1981. Behavioural interactions between coho salmon (*Oncorhynchus kistuch*), Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), and steelhead trout (*Salmo gairdneri*) at the juvenile fluviate stages. Canadian Technical Report of Fisheries and Aquatic Sciences **1029**. 116 pp.

Hearn, W.E. & B.E. Kynard. 1986. Habitat utilization and behavioural interaction of juvenile Atlantic salmon (*Salmo salar*) and rainbow trout (*Salmo gairdneri*) in tributaries of the White River of Vermont. Can. J. Fish. Aquat. Sci. **43**: 1988-1998.

Hickey, T. E. 1983. Preliminary assessment of Atlantic salmon habitat potential of selected streams in Gros Morne National Park, 1983. Prepared for Gros Morne National Park, Newfoundland, Canada, Contract No. GM-83-15.

Kerekes, J. and P. Schwinghamer. 1975. Gros Morne National Park, Nfld. Aquatic Resources Inventory Part 3. Hydrographic Maps, Area and Volume Curves. Environment Canada, Canadian Wildlife Service, Halifax.

Knight, T.W. 2001. A preliminary assessment of the status of the Atlantic salmon (*Salmo salar* L.) Stock in Deer Arm Brook, Gros Morne National Park of Canada, Newfoundland. Canadian Stock Assessment Secretariat Research Document 2001/032.

Mullins, C.C., D.Caines and S.L. Lowe. 2001. Status of the Atlantic salmon (*Salmo salar* L.) Stocks of Lomond River, Torrent River and Western Arm Brook, Newfoundland, 2000. Canadian Stock Assessment Secretariat Research Document 2001/039.

Mullins, C.C., and T.R. Porter. 2002. Rainbow trout (Oncorhynchus mykiss) investigations in Trout River, Newfoundland, 2001. Canadian Stock Assessment Secretariat Research Document 2002/032.

O'Connell, M.F. and J.B. Dempson. 1995. Target spawning requirements for Atlantic salmon, *Salmo salar* L., in Newfoundland rivers. Fisheries Management and Ecology **2**: 161-170

Parks Canada. 1990. Gros Morne National Park, Salmonid Management Plan. Internal Report. Gros Morne National Park, Newfoundland, Canada.

Porter, T.R. 2000. Observations of Rainbow Trout (*Onchorynchus mykiss*) in Newfoundland 1976 to 1999. Canadian Stock Assessment Secretariat Research Document 2000/043.

Table 1: Results of analysis for Trout River using DFO 2001 preliminary catch data and **MW** data from Lomond River salmon.

	Large Salmon	Grilse	Total **ED**	% **CR**
Spawning Escapement (**SE**)	14.8	7.3		
Fecundity (**F**)	6454	2817		
Potential egg deposition (**ED**) low proportion female	60946	12051	72997	13.5
Potential egg deposition (**ED**) high proportion female	81866	16905	98770	18.3

Table 2: Results of analysis for Trout River using DFO 2001 preliminary catch data and **MW** data from Deer Arm Brook salmon.

	Large Salmon	Grilse	Total **ED**	% **CR**
Spawning Escapement (**SE**)	14.8	7.3		
Fecundity (**F**)	7389	3702		
Potential egg deposition (**ED**) low proportion female	69768	15834	85602	15.8
Potential egg deposition (**ED**) high proportion female	93716	22211	115927	21.4

Table 3: Results of analysis for Trout River using DFO 1992-1996 mean catch data and **MW** data from Lomond River and Deer Arm Brook salmon.

		Large Salmon	Grilse	Total **ED**	% **CR**
MW data from (river)	Spawning Escapement (**SE**)	14.9	15.6		
Lomond	**ED** (low proportion female)	61522	25687	87209	16.1
	ED (high proportion female)	82640	36032	118672	21.9
Deer Arm	**ED** (low proportion female)	70428	33751	104178	19.3
	ED (high proportion female)	94602	47343	141946	26.2

Table 4: Results of analysis for Trout River using 100 % **SE** data and **MW** data from Lomond River and Deer Arm Brook salmon.

		Large Salmon	Grilse	Total **ED**	% **CR**
MW data from (river)	Spawning Escapement (**SE**)	15	36		
Lomond	**ED** (low proportion female)	61769	59430	121200	22.4
	ED (high proportion female)	82972	83365	166337	30.7
Deer Arm	**ED** (low proportion female)	70710	78087	148797	27.5
	ED (high proportion female)	94982	109535	204517	37.8

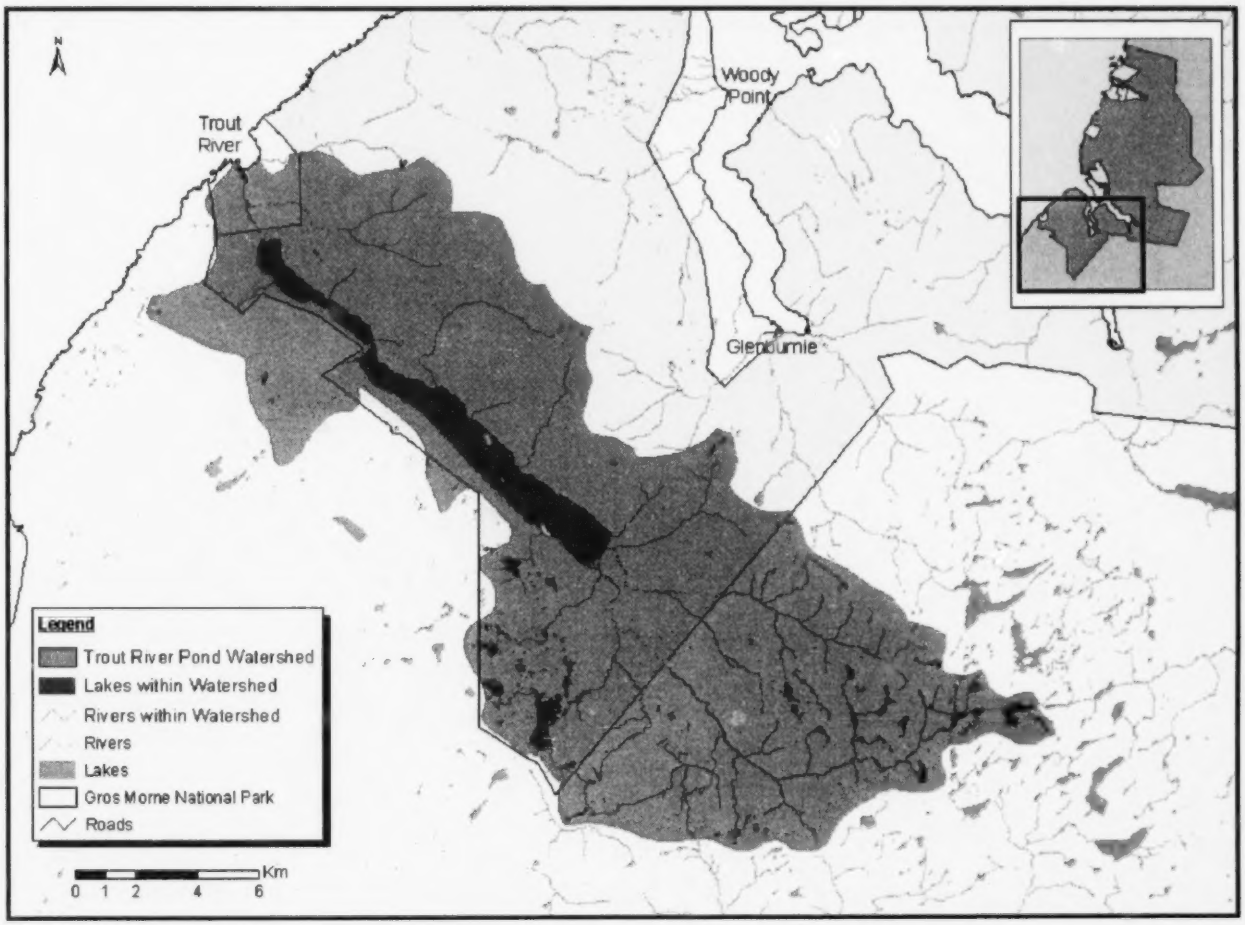

Figure 1: Trout River watershed. Approximately 55% of the watershed is contained within the boundaries of Gros Morne National Park of Canada.

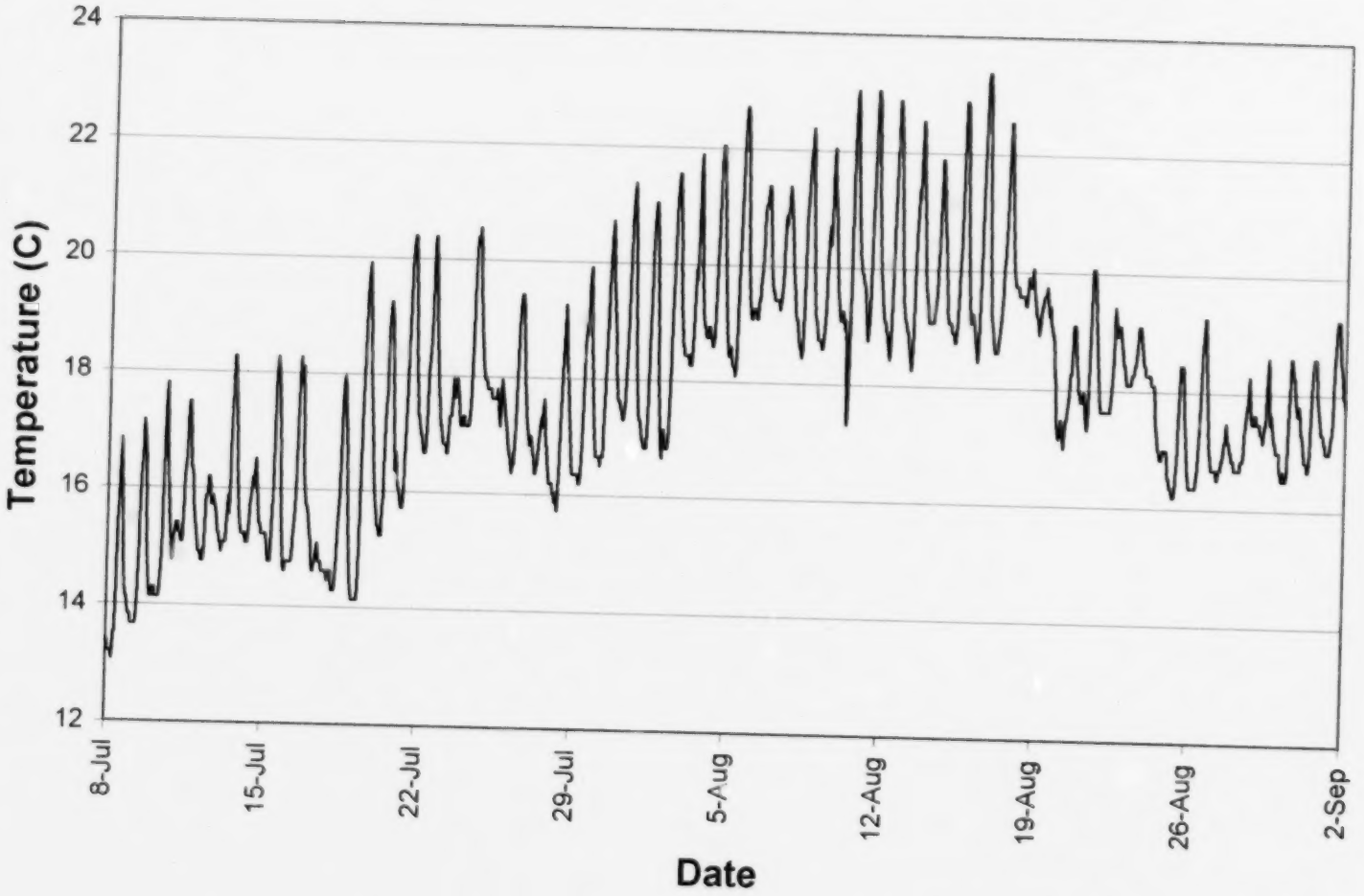

Figure 2: Hourly water temperatures at Trout River fish fence 2001.

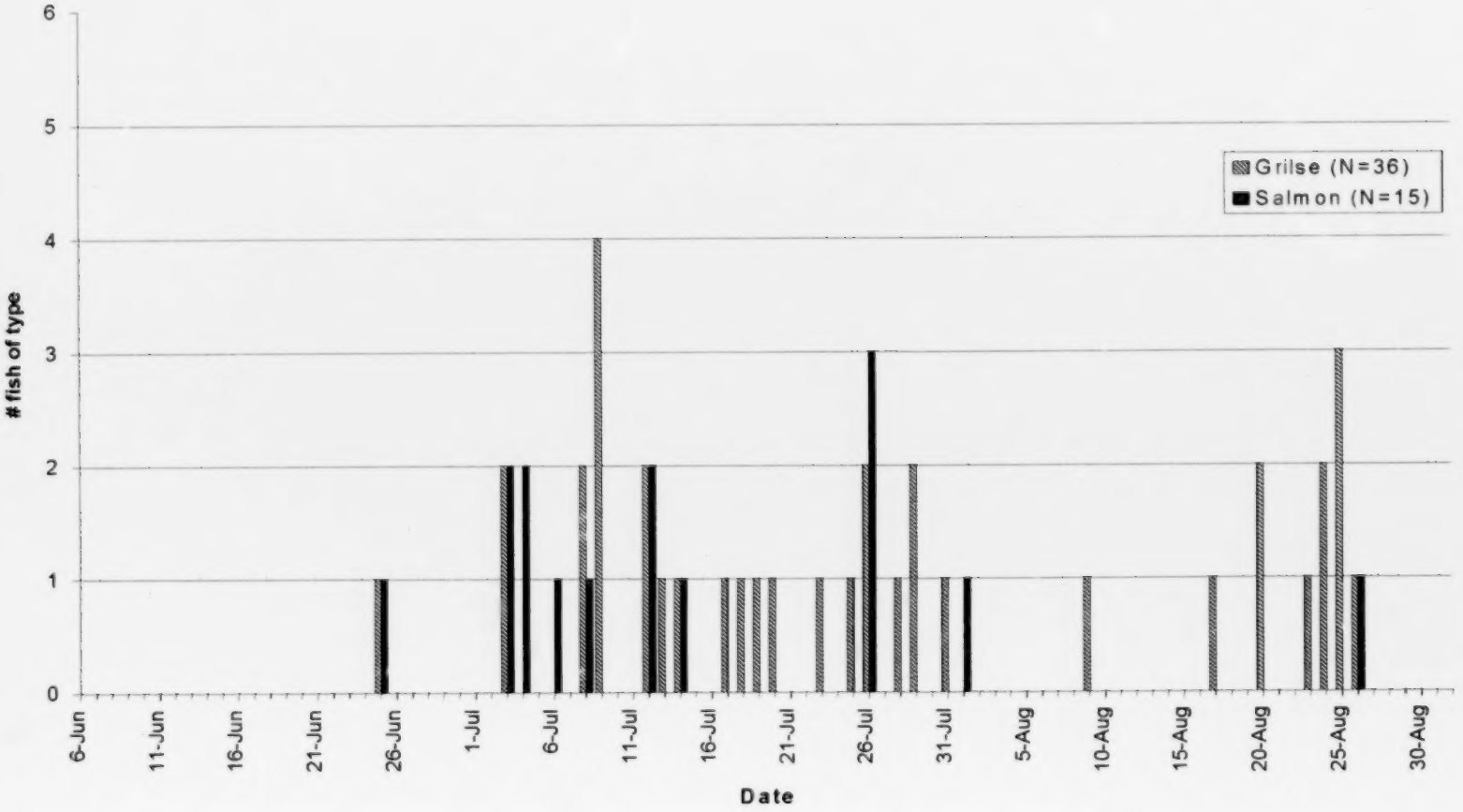

Figure 3: 2001 Trout River adult trap results for Atlantic salmon, large and grilse.